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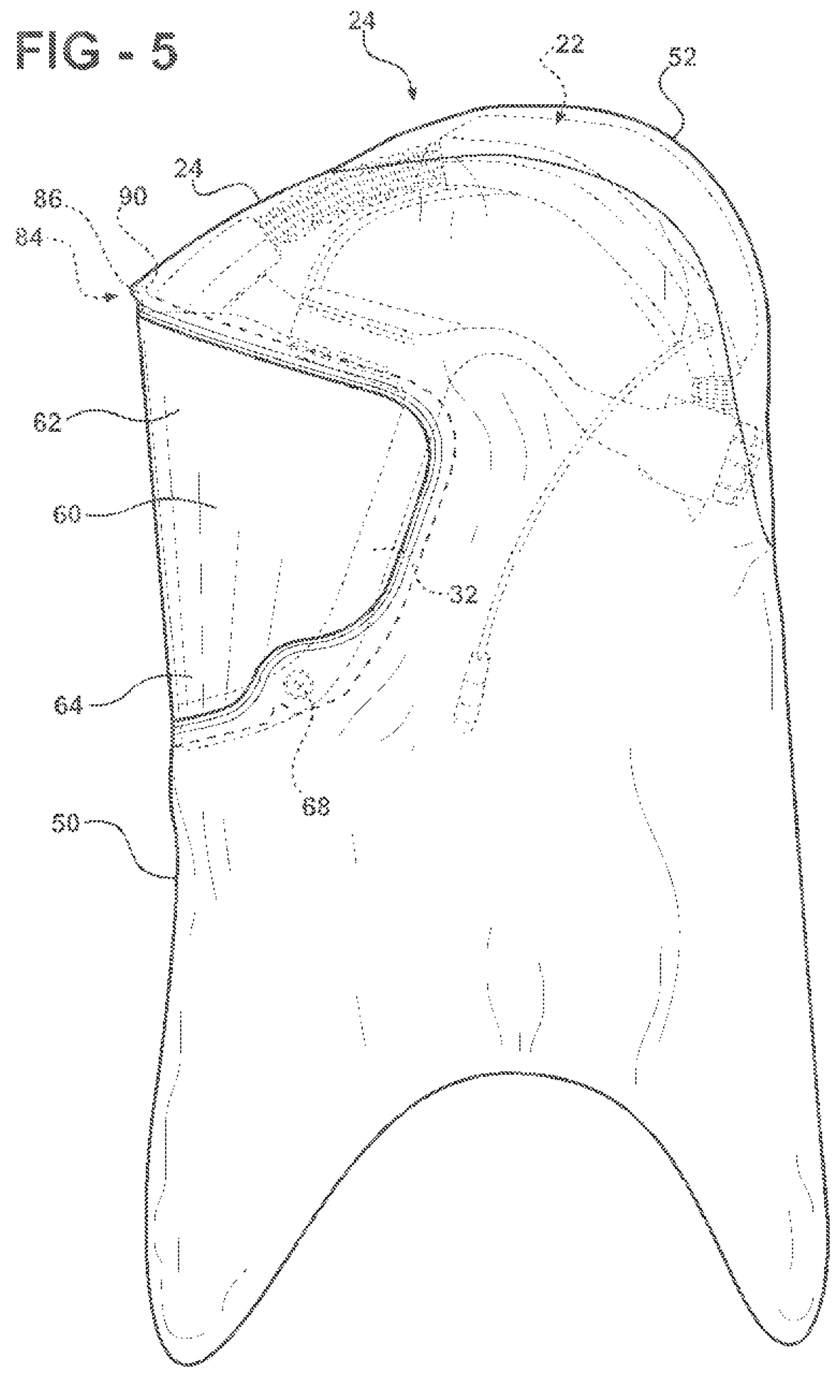
(54) Titre : SYSTEME DE PROTECTION PERSONNELLE AVEC CASQUE AYANT DES COMMANDES D'ACCES FACILE ET UNE PROTECTION FACIALE AYANT UNE GEOMETRIE POUR EVITER LES EBLOUISSEMENTS

(54) Title: PERSONAL PROTECTION SYSTEM WITH HELMET HAVING EASY ACCESS CONTROLS AND FACE SHIELD WITH GLARE AVOIDING GEOMETRY

FIG - 5



(57) Abrégé/Abstract:
A personal protection system (20) including a helmet (22) with a fan (38). A hood (24) is removably fitted over the helmet to provide a barrier around the head. The hood has a transparent face shield (60) through which the individual views the environment. The

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(57) Abrégé(suite)/Abstract(continued):
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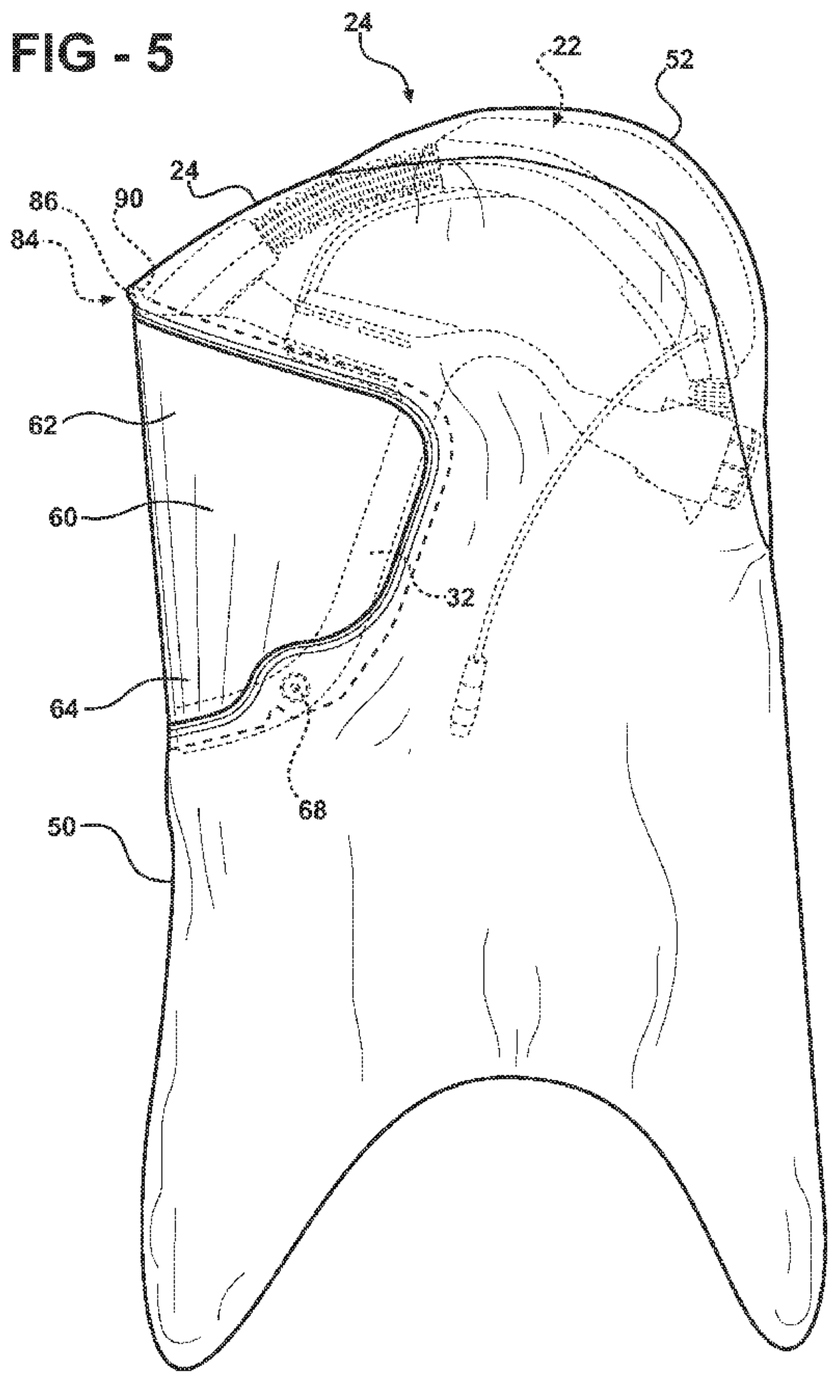

(57) Abstract: A personal protection system (20) including a helmet (22) with a fan (38). A hood (24) is removably fitted over the helmet to provide a barrier around the head. The hood has a transparent face shield (60) through which the individual views the environment. The face shield is curved to both minimize the glare to which the individual is exposed and the extent the f ield-of-view includes the inside of the hood.

WO 2009/079292 A1

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PERSONAL PROTECTION SYSTEM WITH HELMET HAVING EASY ACCESS CONTROLS AND FACE SHIELD WITH GLARE AVOIDING GEOMETRY

FIELD OF THE INVENTION

[0001] The present invention generally relates to personal protection systems for use in medical environments, such as surgical environments, to protect patients from contamination during medical procedures, and to protect medical professionals from exposure to airborne contaminants and bodily fluids. More particularly, the present invention relates to protective coverings of personal protection systems and controls for helmets of personal protection systems.

BACKGROUND OF THE INVENTION

[0002] Personal protection systems are known in the art. Personal protection systems are worn by professionals throughout the medical field, such as surgeons, during surgical procedures. Personal protection systems are used in surgical procedures to provide a sterile barrier between the wearer and the patient. One such system is disclosed in U.S. Patent No. 5,054,480. Specifically, the traditional system includes a helmet that supports a toga or a hood. This assemblage is worn by surgical personnel that want to establish the sterile barrier. The toga or the hood includes a transparent face shield. The helmet includes a ventilation unit with a fan. The ventilation unit draws air through the toga/hood so the air is circulated around the wearer. This reduces both the amount of heat that is trapped within the toga/hood and the CO_2 that builds up in this space.

[0003] Conventional personal protection systems do a reasonable job of providing a sterile barrier between the

surgical personnel and the surrounding environment. However, there are some limitations associated with their use. The face shields associated with prior art togas/hoods create an undesirable amount of glare. In particular, due to the shape of the face shields utilized, undesirable amounts of light reflect off an inside surface of the face shields and are directed toward the eyes of the wearer. This means that an individual wearing the system may be unable to focus on the area being targeted for surgery.

[0004] Furthermore, there are typically one or more control buttons associated with a personal protection system. At a minimum, these control buttons are provided to give the system wearer some control over helmet fan speed. If a personal protection system also includes a communications sub-system, these control buttons are provided to allow the system wearer to control such variable as speaker volume or microphone active/mute. A personal protection system with a light can include a control button that allows the wearer to regulate the on/off state and intensity of the light.

[0005] To date, it has been a practice to locate these control buttons near the waist of the wearer, near the battery pack. A problem with locating these control buttons at this location is that this location is outside of the sterile field (the area forward of the front of the wearer's body. This means that when an individual wanting one of the above environmental features of the personal protection system adjusted, he/she must request that a circulating nurse perform the adjustment. This adds to the duties of the circulating nurse. Further, it may not result in the adjustment of the feature of the system to degree desired by the wearer.

[0006] As an alternative to placing the system control buttons outside of the sterile field, they are mounted to the outer shell of the system helmet. Once the system is fitted to the wearer, the buttons are located above head. Such a system is disclosed in the Applicants' Assignees U.S. Pat. Pub. No. 2007/0028372 A1, the contents of which are explicitly incorporated by reference. The wearer then actuates these buttons by pressing the section of hood that covers the button. This does provide the individual with direct control of the environmental features of the system. However, this arrangement is not without its own disadvantages. The location of the buttons, above the head, is awkward to reach. Further, in some surgical procedures, immediately above the head of the surgical personnel is a light. When an individual wearing this type of personal protection system reaches above his/her head to access the control buttons care must be taken to avoid bumping the light.

SUMMARY OF THE INVENTION

[0007] The present invention provides a personal protection system for providing a sterile barrier between a user and an external environment. The system comprises a helmet designed to be worn on the head of the user. The helmet includes a support structure and a ventilation unit with a fan supported by the support structure. The ventilation unit discharges air toward the user. A chin bar depends from the support structure. The helmet may also include a communications module that allows the user to speak to other personnel without having to shout through the hood.

[0008] A hood or toga drapes over the helmet. The hood is designed to fit loosely over the helmet and typically

only extends a short distance below the individual's neck or shoulders. A toga is a garment that includes the hood and typically covers more of the body, such as from chest to near the knees and the arms. The hood includes a filter section for filtering air drawn into the hood from the external environment by the ventilation unit. The hood includes a flexible and transparent face shield. The face shield includes a top portion, a bottom portion, and a sealing perimeter. The hood has an opening in which this shield is seated. The shield is sealed to this opening such that the shield perimeter overlaps the section of the hood that defines the shield opening.

[0009] The face shield is mounted to the helmet with a first radius of curvature along the bottom portion and a second radius of curvature along the top portion. The first radius of curvature is smaller than the second radius of curvature. In some versions of the invention, this geometry is created by providing the helmet and shield with complementary mounting components so that, when the hood is placed over the helmet and the mounting components are engaged, the shield bends to develop this curvature.

[00010] The relatively wide radius of curvature adjacent around the top of the shield reduce glare that results from light being reflected off an inside surface of the face shield. The smaller radius of curvature adjacent the bottom of the shield increases the wearer's field of view outside of the shield.

[00011] It is still another feature of the personal protection system of this invention that the control buttons for regulating the environmental assemblies of the system are mounted to the chin bar. In some versions of the invention, these buttons are mounted to an inner surface of the chin bar. When the hood is placed over the helmet, the

individual readily accesses these buttons by simply pushing the buttons against the chin bar. The individual is able to press the buttons by pressing over the portion of the hood that covers the buttons. Thus, the individual is able to depress buttons without breaking the sterile barrier.

Brief Description of the Drawings

[00012] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[00013] Figure 1 is a perspective view of a personal protection system including a protective covering draped over a helmet;

[00014] Figure 2 is a front perspective view of the helmet;

[00015] Figure 2A is a top view of the helmet;

[00016] Figure 3 is a front view of the protective covering including a face shield;

[00017] Figure 4 is a rear view of the face shield with the protective covering being inside-out;

[00018] Figure 5 is a side view of the protective covering;

[00019] Figure 6 is a front perspective view of the face shield of the protective covering illustrating a first radius of curvature at the bottom of the face shield and a second radius of curvature at the top of the face shield;

[00020] Figure 7A is an illustration of a top of a face shield of the prior art;

[00021] Figure 7B is an illustration of a top of the face shield of the present invention;

[00022] Figures 8-11 illustrate a procedure for mounting the protective covering to the helmet and draping the protective covering over the helmet;

[00023] Figure 12 is a rear view of the helmet including a control panel on a chin bar of the helmet; and

[00024] Figure 13 is a blown-up view of the control panel from Fig. 12.

DETAILED DESCRIPTION OF THE INVENTION

[00025] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a personal protection system is generally shown at 20.

[00026] Referring to FIGS. 1, 2, and 2A, the personal protection system 20 is shown to include a helmet 22. The personal protection system 20 also includes a protective covering, a hood 24, with an integrated face shield 60 for draping over the helmet 22. This hood 24 may only cover the upper torso and/or arms of the wearer. Alternatively, the hood may by be part of large garment, often called a "toga," that covers more of the wearer. System 20 creates a sterile barrier between the wearer and an external environment. The system 20 is useful in many medical environments, but is particularly adapted for use in surgery to protect patients from contamination during surgical procedures and to protect medical professionals from exposure to airborne contaminants and bodily fluids.

[00027] FIGS. 2 and 2A illustrate the helmet 22. The helmet 22 is generally adapted from the helmets shown in U.S. Patent No. 6,481,019 to Diaz et al. and VanDerWoude et al.'s U.S. Pat. Pub. No. 2007/0028372 A1, both of which are hereby incorporated by reference.

[00028] Helmet 22 includes a support structure 28. The support structure 28 includes an adjustable head band 30 for

mounting the helmet 22 to a head of the user. A chin bar 32 depends downwardly from the front of the head band 30 to define a facial opening 34. More particularly, chin bar 32 includes two legs 33 that extend down from the head band 30 on the opposed sides of the face of the individual wearing the helmet 22. Located in front of and slightly below the chin, chin bar 32 has a curved cross beam 35 that extends between the free end of legs 33.

[00029] The support structure 28 also supports a ventilation unit 36. The ventilation unit 36 includes a fan 38 for generating air flow to direct air toward the user. In some embodiments, the support structure 28 also supports a communications unit 40 including a microphone 42 (see FIGS. 12 and 13). Details of the support structure, 28 head band 30, ventilation unit 36, fan 38, and communications unit 40 are disclosed in the incorporated by reference U.S. Pat. Pub. No. 2007/0028372 A1.

[00030] Referring to FIGS. 3-5, hood 24 is shown. The hood 24 includes a shell 50 shaped to fit relatively loosely over the helmet 22 including chin bar 32. The top of shell 50 is open. A filter section 52 is attached over the open top of the shell 50 to form the top of the hood 24. Filter section 52 is formed from a filter medium such as a meltblown or triboelectret nonwoven having a porosity suitable for filtering particles of 0.1 microns or greater from air entering the shell 50 from the external environment. This filter section is positioned to above the intake for the ventilation unit 36. Thus, the filter section 36 removes particulates in the air stream the ventilation unit draws into the hood 24. An intake grid 54 (see FIG. 12), that is part of the helmet 22, prevents the filter section 52 from being drawn into the helmet by fan 38.

[00031] Hood shell 50 itself is formed from a barrier fabric. In one version of the invention the barrier fabric is as a multilaminate nonwoven fabric comprised of polyethylene, polypropylene, or polyester, or any combination thereof, to prevent fluids and particulate from passing through the shell 50. Hood shell 50 is formed to be loose around the perimeter of the helmet 22 and, by extension, the head of the wearer

[00032] A flexible and transparent face shield 60 permits the user to view through the hood 24. As shown in FIG. 1, the face shield 60 is mounted to the shell 50 such that the face shield 60 covers the facial opening 34 of the helmet 22 once the user dresses into the personal protection system 20.

[00033] Referring specifically to FIGS. 3 and 4, the face shield 60 includes a top portion 62, a bottom portion 64, and a sealing perimeter 66. The top portion 62 defines the top one-half of the face shield 60 and the bottom portion 64 defines the bottom one-half. The shell 50 is sealed to the face shield 60 on an outside surface 67 of the face shield 60 along the sealing perimeter 66. The shell 50 may be sealed to the face shield 60 by an adhesive or by welding. The face shield 60 has a height H, defined within the sealing perimeter, of at least 6.75 inches (17.15 cm) and a width W, perpendicular to the height H, defined within the sealing perimeter, of at least 10.5 (26.67 cm) inches. The minimum height H and width W are designed to provide a suitable viewing area for the wearer through the face shield 60. In particular, the width W provides a suitable peripheral view for the wearer to watch activities occurring to the sides of the wearer. The face shield 60 is preferably formed of a sterilizable material. In one

embodiment, the face shield 60 is formed of Lexan® 8010 plastic have a thickness of approximately 15 mils (0.4 mm).

[00034] An upper mounting element 80 is disposed on the face shield 60 along the top portion 62 of the face shield 60. The upper mounting element 80 is preferably centered on the face shield 60 along the top portion 62. In one embodiment, the top portion 62 is free of mounting elements on opposing sides of the upper mounting element 80 such that the upper mounting element 80 is the only mounting element along the top portion 62. The upper mounting element 80 is preferably an aperture 82 defined through the face shield 60. The upper mounting element 80 is configured for fastening to an upper mounting device 84 included on the helmet 22.

[00035] Helmet upper mounting device 84 is positioned to be located a plane that bisects the helmet, front-to-rear. The helmet upper mounting device 84 is thus located along the longitudinal, top-to-bottom, axis of helmet facial opening 34. In the illustrated version of the invention, upper mounting device 84 is a single mounting clip 86. Mounting clip 86 extends upwardly from a front nozzle assembly 88 of the helmet 22. The mounting clip 86 includes a distal edge 90 extending outwardly from the nozzle assembly 88 such that a portion 92 of the face shield 60 rests between the distal edge 90 and the nozzle assembly 88 after the face shield 60 is mounted to the mounting clip 86 to support the hood 24. The mounting clip 86 interlocks with the aperture 82 centered on the face shield 60 to center the face shield 60 over the helmet facial opening 34. More specifically, the mounting clip 86 protrudes through shield aperture 82 when mounting the face shield 60 to the helmet 22.

[00036] Two lower mounting elements 68 are disposed on the face shield 60 along the bottom portion 64 of the face shield 60. In the described version of the invention, lower mounting elements 68 are preferably magnets or are formed of magnetically attractive material. In one embodiment, the lower mounting elements 68 are magnetic rivets mounted to the face shield 60. In this embodiment, the lower mounting elements 68 penetrate through the face shield 60. The lower mounting elements 68 are configured to fasten to complementary lower mounting devices 70 on the chin bar 32 of the helmet 22 to secure the bottom portion 64 of the face shield 60 to the chin bar 32. See FIGS. 2 and 6. FIG. 2 shows only one of the lower mounting devices 70, but another lower mounting device 70 is positioned directly on the opposite side of the chin bar 32.

[00037] Helmet lower mounting devices 70 are preferably magnets or are formed of magnetically attractive material configured to attract the lower mounting elements 68. This attraction makes it easier for the user to properly position the bottom portion of the face shield 60 on the helmet 22. In other embodiments, the lower mounting elements 68 and lower mounting devices 70 can be mating snap components, hook and loop fasteners, and the like.

[00038] The lower mounting elements 68 and the upper mounting element 80 are preferably mounted along an outer portion 71 of the face shield 60e. The outer portion 71 is defined between an outer periphery of the face shield 60 and the sealing perimeter 66. As a result, when the shell 50 is glued or adhered to the face shield 60 along the sealing perimeter 66, which is defined on the outside surface 67 of the face shield 60, the lower mounting elements 68 and the upper mounting element 80 are hidden beneath the shell 50, out of view from an external perspective (see FIG. 3). This

is particularly advantageous since the penetrations in the face shield 60 from the mounting elements 68, 80 would otherwise require some manner of ensuring that fluids and particulate could not penetrate therethrough. With the mounting elements 68, 82 disposed beneath the shell 50, these penetrations are protected.

[00039] Referring specifically to FIG. 6, the upper 80 and lower 68 mounting elements define three mounting locations at which the face shield 60 mounts to the helmet 22. Although the helmet 22 is not illustrated in FIG. 6 for clarity, the face shield 60 is shown in its mounted configuration as though mounted to the helmet 22. The two lower mounting locations provide the face shield 60 with a first radius of curvature R_1 along the bottom portion 64 when the face shield is mounted to the helmet 22 using the lower mounting elements 68. The upper mounting location provides a second radius of curvature R_2 along the top portion 62 when the face shield 60 is mounted to the helmet using the upper mounting element 80. The first radius of curvature R_1 is smaller than the second radius of curvature R_2.

[00040] Preferably, the first radius of curvature R_1 is at least 4.0 inches (10.2 cm) and the second radius of curvature R_2 is at least 5.0 inches (12.7 cm). The first radius of curvature R_1 preferably ranges from 4.0 inches (10.2 cm) to 10 inches (25.4 cm), more preferably from 4.0 inches (10.2 cm) to 7.5 inches (19.1 cm), and most preferably from 4.0 inches (10.2 cm) to 4.9 inches (12.5 cm). The second radius of curvature R_2 ranges from 5.0 inches (12.7 cm) to 15 inches (38.1 cm), more preferably from 5.0 inches (12.7 cm) to 10 inches (25.4 cm), and most preferably from 5.0 inches (12.7 cm) to 6.0 inches (15.2 cm). In one specific embodiment, the first radius of curvature R_1 is 4.6 inches (11.7 cm) and the second radius of

curvature R_2 is 5.5 inches (14.0 cm). A distance D between a first arc A_1 of the face shield 60 that lies at the first radius of curvature R_1 and a second arc A_2 that lies at the second radius of curvature R_2 is at least 6.75 inches (17.1 cm), more preferably at least 7.5 inches (19.1 cm). In one embodiment, the first arc A_1 is disposed at a bottom of the viewing area and the second arc A_2 is disposed at a top of the viewing area. The distance D may be defined along the height H of the face shield 60, which is perpendicular to an arc between the lower mounting elements 68.

[00041] By having a relative large radius of curvature along the top portion 62, less light is reflected off the inside surface 75 of the face shield 60 toward the eyes of the user. This reduces glare. Instead, the light reflects off the face shield 60 to opposite sides of the user's eyes. This is illustrated in FIGS. 7A and 7B. In FIG. 7A, a prior art face shield is shown. This face shield has a relatively small radius of curvature such that the user's eyes receive significant amounts of reflected light in the form of glare. Conversely, the top portion 62 of the face shield 60 shown in FIG. 7B has a sufficiently large radius of curvature to direct reflected light out of the path of the user's eyes. Both the prior art face shield and the face shield 60 of the present invention can be designed with the same peripheral viewing distance P, but the face shield 60 of the present invention avoids glare.

[00042] The distance between the two curves R_1 and R_2 and the relative small radius of curvature of the lower curve R_1 provides another benefit of system 30 of this invention. Collectively, these features provide shield 60, when system 20 is assembly a shape equal to the surface slice of a section of a cylinder where the apex is below the helmet.

As a consequence of shield 60 having this curvature, the field-of-view of the wearer consists primarily of objects outside of the shield. Only when the eyes are directed to the far right, the far left, the sky or the floor immediately below the wearer does the inside of the hood 24 occupy a substantial fraction of the view. This minimization of the extent to which the wearer views the inside of the hood 24 reduces the likelihood that the wearer, using system 20 of this invention, feels unnaturally enclosed or confined.

[00043] Referring to FIG. 5, the shell 50 is configured with an adequate amount of material and flexibility so as to not constrain the face shield 60 into a smaller radius of curvature than that indicated. In other words, the amount of material and configuration of the material for the shell 50 permits some slack in the hood 24 when draped over the helmet 22 so that the face shield 60 can flex outwardly at the top portion 62 to be at the larger radius of curvature R_2. The face shield 60 is preferably formed from a generally flat piece of material that is then shaped to fit to the helmet 22 in the manner described. In the embodiment in which the top portion 62 is unattached on opposite sides of the upper mounting element 80, the top portion 62 flexes toward its normally flat position and is only constrained by the lower mounting elements 68. This allows the top portion 62 to flex further out than the bottom portion 64 giving the top portion 62 a larger radius of curvature.

[00044] Referring to FIGS. 8-11, the steps taken to fit the system 20 onto a user are shown. As understood by those skilled in the art, an individual wearing system 20 “dress into” the system 20 by first mounting the helmet 22 on his/her head. Next, as shown in FIGS. 8 and 9, the face shield 60 is mounted to the helmet 22. First, the aperture

82 is placed over the mounting clip 86. Second, the lower mounting elements 68 on the face shield 60 are fastened to the lower mounting devices 70 on the chin bar 32. As described above, this may simply require generally aligning the lower mounting elements 68 with the lower mounting devices 70 with magnetic forces fastening them to one another. Again, it should be understood that the material from which face shield 60 is formed is flexible.

[00045] The helmet mounting devices 70 are located rearward of helmet mounting clip 86. The bottom located chin bar cross beam 35 has a curvature that is slightly less than the desired bottom curvature, R_1 radius of the face shield. Accordingly, to perform the latter portion of the shield mounting process, the bottom shield is appreciably bent from its flat profile. Specifically it develops the curve with the small R_1 radius. In the described version of the invention, only the single, center-located clip-in-aperture mounting assembly holds the top of the face shield 60 to the helmet 22. Consequently, the top of face shield 60 during this mounting process is bent less than the bottom of the face shield. This is why, during the hood fitting process, the top of the face shield 60 bends enough to develop the large R_2 radius.

[00046] Referring to FIGS. 10 and 11, once the face shield 60 is secured to the helmet 22, the shell 50 is pulled over the helmet 22 and draped over the helmet 22. As part of this process, the front of the hood 24 is pulled below helmet chin bar 32. Once hood 22 is so mounted, the hood provides a barrier between the wearer and the external environment. Although not shown, the wearer may then dress into a gown that accommodates the hood 24.

[00047] Since the mounting clip 86 and the aperture 82 are in the centered relationship described above, the face

shield 60 is automatically centered relative to the facial opening 34 of the helmet 22, and there is no need for the user to repeatedly adjust the face shield 60.

[00048] Referring to FIGS. 12 and 13, during use of the system 20, the wearer has access to a control panel 100 for regulating the actuatable units, the ventilation unit 36 and communications unit 40. Specifically, control panel 100 allows for adjustment a speed of the fan 38 and to mute the microphone 42 of the communications unit 40. The control panel 100 is disposed on the inside surface, inside face the chin bar cross beam 35. The control panel 100 preferably includes a plurality of control switches for the fan 38 and the microphone 42. In particular, referring specifically to FIG. 13, two fan control buttons 102A and 102B are shown for increasing and decreasing the speed of the fan 38. Similarly, a mute button 104 is shown for muting the communications unit 40. The fan control buttons 102 and the mute button 104 can be configured in the manner described in U.S. Patent No. 6,481,019 to Diaz et al. or Application Serial No. 11/485,783 to VanDerWoude et al., both of which are hereby incorporated by reference for their disclosure of the operation of their fan control switches and muting switches.

[00049] It will be noted that the buttons 102a, 102b and 104 have different shapes. In the illustrated version of the invention, button 102A is in the shape of a triangle with an upwardly oriented apex; button 102B is in the shape of a triangle with a downwardly directed apex; button 104 is circular in shape.

[00050] When an individual wearing system 20 of this invention wants to actuate one of the environmental control buttons 102A 102B or 104 all that she/he has to is reach to the underside of the chin bar 32. The individual can do

this while still wearing the hood so as to not break the sterile barrier established by the hood 24. Given the fact that each button has a different shape, the individual can use touch to determine which of the buttons her/his finger is set to depress. Once the individual determines that her/his finger is over the correct button, that button can be depressed. It should be appreciated that when performing this action, typically the palm of the hand is located against the outside of the chin bar 32, (again separated from the chin bar by the hood 24.) The palm provides a static surface against which the chin bar 32 presses which resists the pushing action of the button-depressing finger. This resistance ensures that the finger force is sufficient to actuate the depressed button.

[00051] Modifications and variations of the present invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims.

[00052] For example, there is no requirement that each of the above described features be in all versions of the invention.

[00053] Similarly, means other than hooks-in-slots and magnets may be used to removable secure the shield 60 to the helmet 22. Likewise there is no requirement in all versions of the invention, three fastening assemblies releaeably hold the face shield to the helmet. For example, in some versions of the invention two or more fastening members may be provided to hold the top of the face shield 60 to the helmet 22 so that it has the desired curvature. In these versions of the invention, the forward part of the helmet may be shaped so that the bottom end, the end against which the bottom of the face shield curves has a first curvature with a radius similar to the R_1 radius. Here the top end of

the forward part of the helmet, the part against which top of the face shield 60 curves as a second curvature greater than the first curvature with a radius similar to the desired R_2 radius. Thus in these versions of the invention both the bottom and top of the front of the helmet provide are shaped to provide the face shield 60, when bent against the helmet has the desired curvature. Similarly, one or three or more fastening members may be used to hold the bottom of the face shield 22 to the helmet so it has the desired curvature.

[00054] In some versions of the invention, the mounting components that hold the hood 24 to the helmet 22 may not be built into the face shield 60. These components could be built into the shell of the hood adjacent the face shield.

[00055] The environment controls mounted to the chin bar 32 may be used to control other environmental features of the system such as speaker volume and the ON/OFF state and intensity of any lighting system integral with the personal protection system of this invention.

[00056] Likewise, there may not be a requirement that in all versions of the invention, the face shield be initially flat and bent to the desired shape. In some versions of the invention, the face shield may be pre formed to have the desired curvature.

[00057] Accordingly, it is the object of the appending claims to cover all such variations and modifications that come within the true spirit and scope of the invention.

What is claimed is:

1. A personal protection system (20) for use by an individual, said system including:

a helmet (22) to be worn around the head of the individual, the helmet including a ventilation unit (36) for drawing air towards the head and a front section (32) located adjacent the face of the individual;

a hood (24) including a shell (50) shaped to be fitted over the helmet and head, and a transparent face shield (60) attached to the shell, the face shield having a top portion (62) positioned adjacent the eyes of the individual and a bottom portion (64) located below the eyes of the individual; and

mounting components (68, 70, 82, 84) integral with the helmet and the hood for releaseably holding the hood over the helmet so the hood face shield is disposed over the helmet front section,

characterized in that:

the helmet (22) and hood (24) are shaped and mounting components are positioned so that when the hood is over the helmet, the face shield top portion (62) has a first radius of curvature and the face shield bottom portion (64) has a second radius of curvature that is less than the first radius of curvature.

2. The personal protection system of Claim 1, wherein the first radius of curvature is at least 12.7 cm.

3. The personal protection system of Claims 1 or 2, wherein:

the helmet front section is a chin bar (32) that extends towards the chin of the individual, the chin bar having a radius of curvature that approximates the second radius of curvature of the face shield (60);

the face shield (60) is formed from flexible material; and

the helmet has mounting components (70) on the chin bar (32)and the hood has complementary mounting components (68) for engaging the chin bar-located mounting components so that when the hood is over the helmet, the mounting components hold the hood to the helmet so the face shield bottom portion (64) bends to develop the second radius of curvature.

4. The personal protection system of Claim 3, wherein the helmet (22) and hood (24) including complementary mounting components (82, 84) for suspending the face shield top portion (62) to the helmet so that, when the hood is over the helmet, the face shield top portion bends less than the face shield bottom portion (64) so that that face shield top portion (62) develops the second radius of curvature.

5. The personal protection system of Claims 1, 2, 3 or 4, wherein at least one of the mounting components (68, 70) associated with the hood (24) is on the face shield (60).

6. The personal protection system of Claim 5, wherein:

the face shield has an outer perimeter portion (71) and a sealing portion (66) located within the outer perimeter and said face shield is attached to the hood around the sealing portion; and

the at least one of the fastening components (68, 70) on the face shield (60) hood is located in the outer perimeter portion (71).

7. The personal protection system of Claims 1, 2, 3, 4, 5 or 6, wherein at least one of the mounting components (68) associated with the hood (24) is designed to magnetically engage a complementary fastening component (70) associated with the helmet (22).

8. The personal protection system of Claims 1, 2, 3, 4, 5, 6 or 7, wherein at least one of the mounting components (82) associated with the hood (24) is an opening designed to receive a complementary clip (86) associated with the helmet.

9. The personal protection system of Claims 1, 2, 3, 4, 5, 6, 7 or 8, wherein: the helmet includes a head band (30) shaped for wear around the head of the individual and the ventilation unit (36) is supported above the head by said head band.

10. A hood for use as part of the personal protection system of any one of Claims 1, 2, 3, 4, 5, 6, 7, 8 or 9, wherein:

the face shield (60) is flexible and has opposed sides;

a single mounting component is located adjacent the top portion (62) of the face shield, the single mounting component being an aperture (82) shaped to receive a clip (84) integral with the helmet (22); and

two mounting components (68) located adjacent the face shield bottom portion (64), each mounting component being located adjacent a separate one of the opposed sides of the face shell, each of the mounting components being able to

releaseably engage a complementary mounting component (70) associated with the helmet.

11. The hood of Claim 10 wherein the two mounting components (68) adjacent the face shield bottom portion (62) are formed from magnetically attractive material.

12. The hood of Claims 10 or 11, wherein:

the face shield (60) has an outer perimeter portion (71) and a sealing portion (66) located within the outer perimeter and said face shield is attached to the shell (50) around the sealing portion; and

at least one of the fastening components (68, 82) associated with the hood (22) is located on the face shield outer perimeter portion (71).

13. The hood of Claims 10, 11 or 12, wherein said hood further includes a porous filter element (52) attached to the shell (50), said filter element being positioned so that, when the hood is over the helmet (22) the ventilation unit (36) draws air in towards the individual through said filter element.

14. A personal protection system (20) for use by an individual, said system including:

a helmet (22) to be worn around the head of the individual, the helmet including: a chin bar (32) positioned to extend in front of the face of the individual; at least one actuatable unit (36, 42) for facilitating operation of the personal protection system; and at least one actuatable control button (102A, 102B, 104) for regulating actuation of the at least one actuatable unit;

a hood (24) including a shell (50) shaped to be fitted over the head and the helmet, including the chin bar (32), and a transparent face shield (60) attached to the shell; and

mounting components (68, 70, 82, 84) integral with the helmet and the hood for releaseably holding the hood over the helmet so the hood face shield is disposed over the helmet front section,

characterized in that:

the at least one control button (102A, 102B, 104) is mounted to the chin bar (32).

15. The personal protection system (20) of Claim 14, wherein:

the chin bar (32) includes legs (33) that extend downwardly from the top of the head and a beam (35) that extends between the legs, the beam being located adjacent the chin of the individual; and

the at least one control button (102A, 102B, 104) is mounted to the chin bar beam (35).

16. The personal protection system of Claims 14, or 15, wherein:

the chin bar (32) includes an outer surface directed away from the face of the individual and an inner surface directed towards the face of the individual; and

the at least one control button (102A, 102B, 104) is mounted to the inner face of the chin bar.

17. The personal protection system of Claims 14, 15 or 16, wherein: said helmet includes a head band (30) shaped for wear against the head of the individual; and the ventilation unit (36) is suspended above said head band.

18. The personal protection system of Claims 14, 15, 16, or 17, wherein said helmet (22) includes a head band (30) shaped for wear against the head of the individual; and the chin bar (32) is suspended from the head band.

19. The personal protection system of Claims 14, 15, 16, 17 or 18, wherein at least one of the helmet mounting components (70) for holding the hood to the helmet is attached to the chin bar (32).

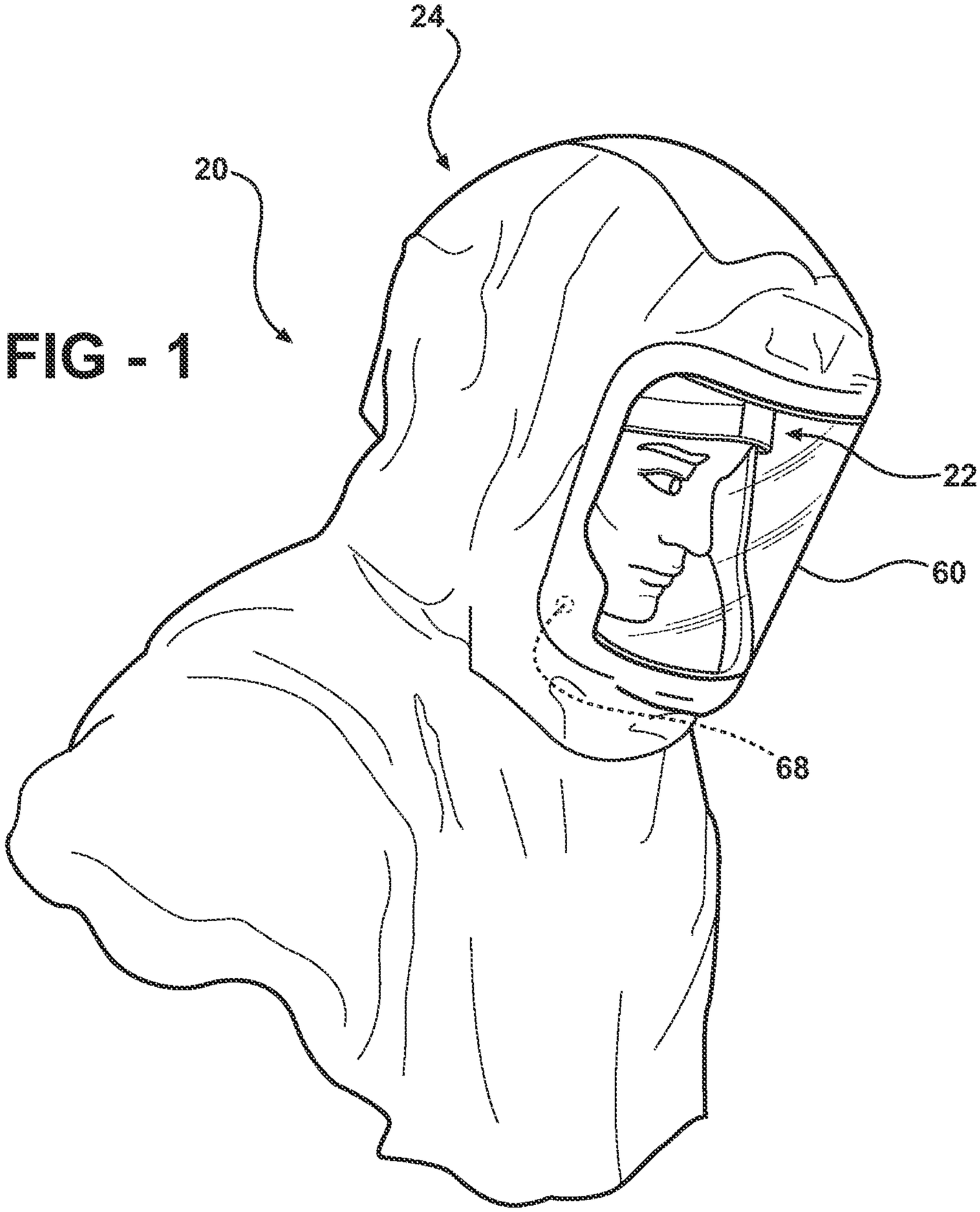
20. The personal protection system of Claims 14, 15, 16, 17, 18, 19, or 20, wherein plural buttons (102A, 102B, 104) are mounted to the chin bar (32) and each button has a unique shape.

21. The personal protection system of Claims 14, 15, 16, 17, 18, 19 or 20, wherein the at least one actuatable unit integral with the helmet (22) is a ventilation unit (36).

22. The personal protection system of Claims 14, 15, 16, 17, 18, 19 or 20, wherein the at least one actuatable unit integral with the helmet is a communications unit (40).

23. The personal protection system of Claims 14, 15, 16, 17, 18, 19, 20, 21 or 22, wherein said hood (24) includes a porous filter element (52) attached to the shell (50).

FIG - 1



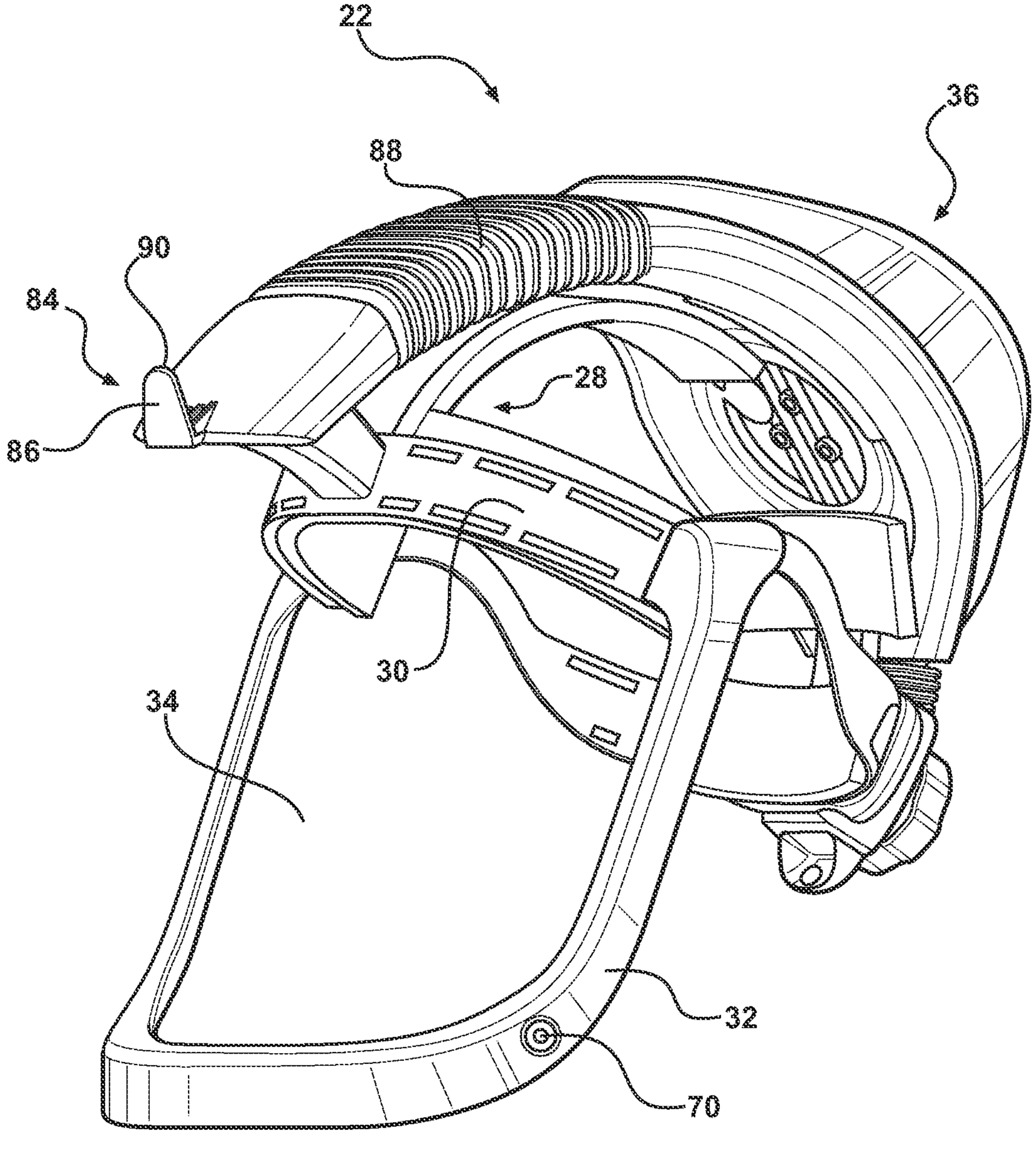


FIG - 2

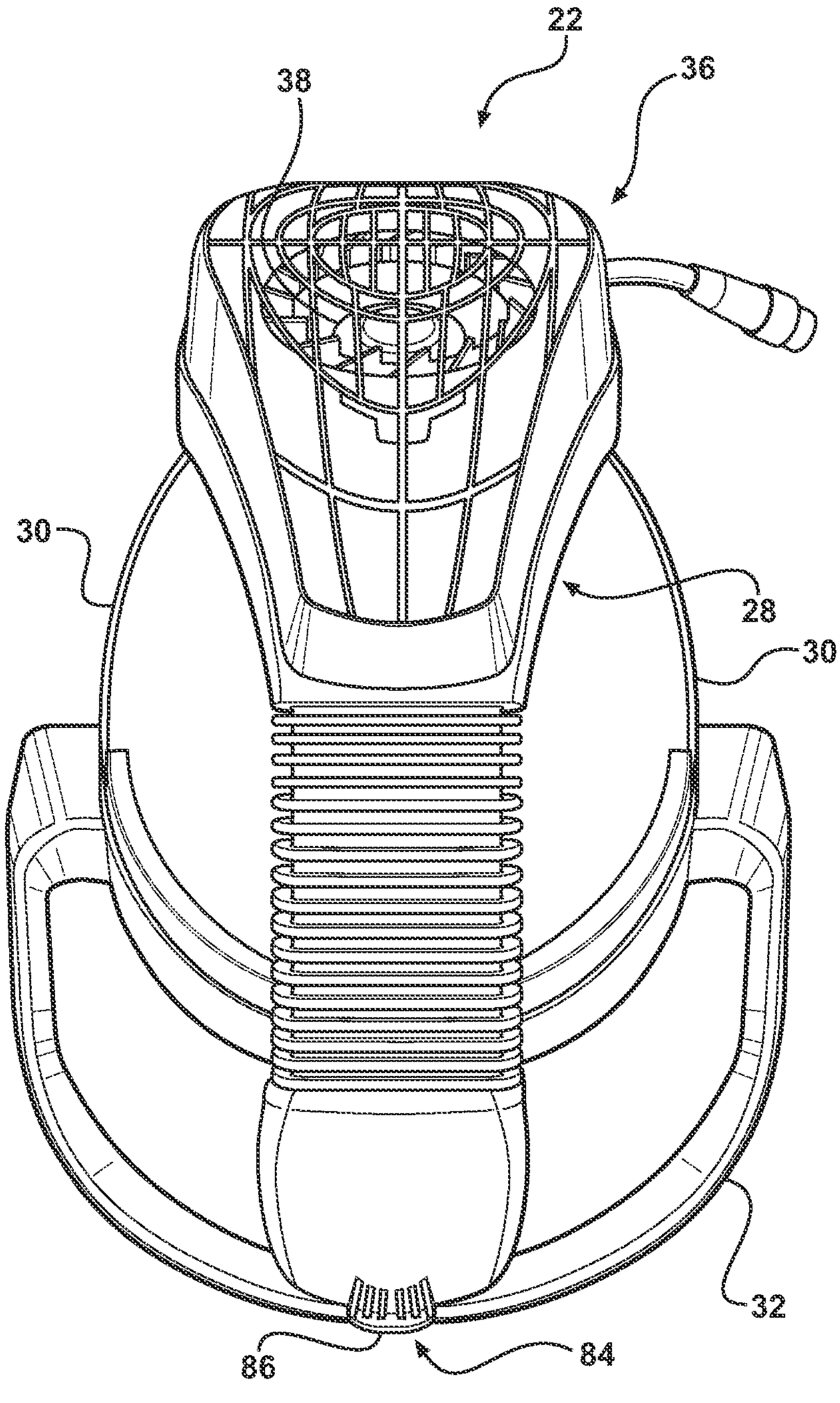


FIG - 2A

FIG - 3

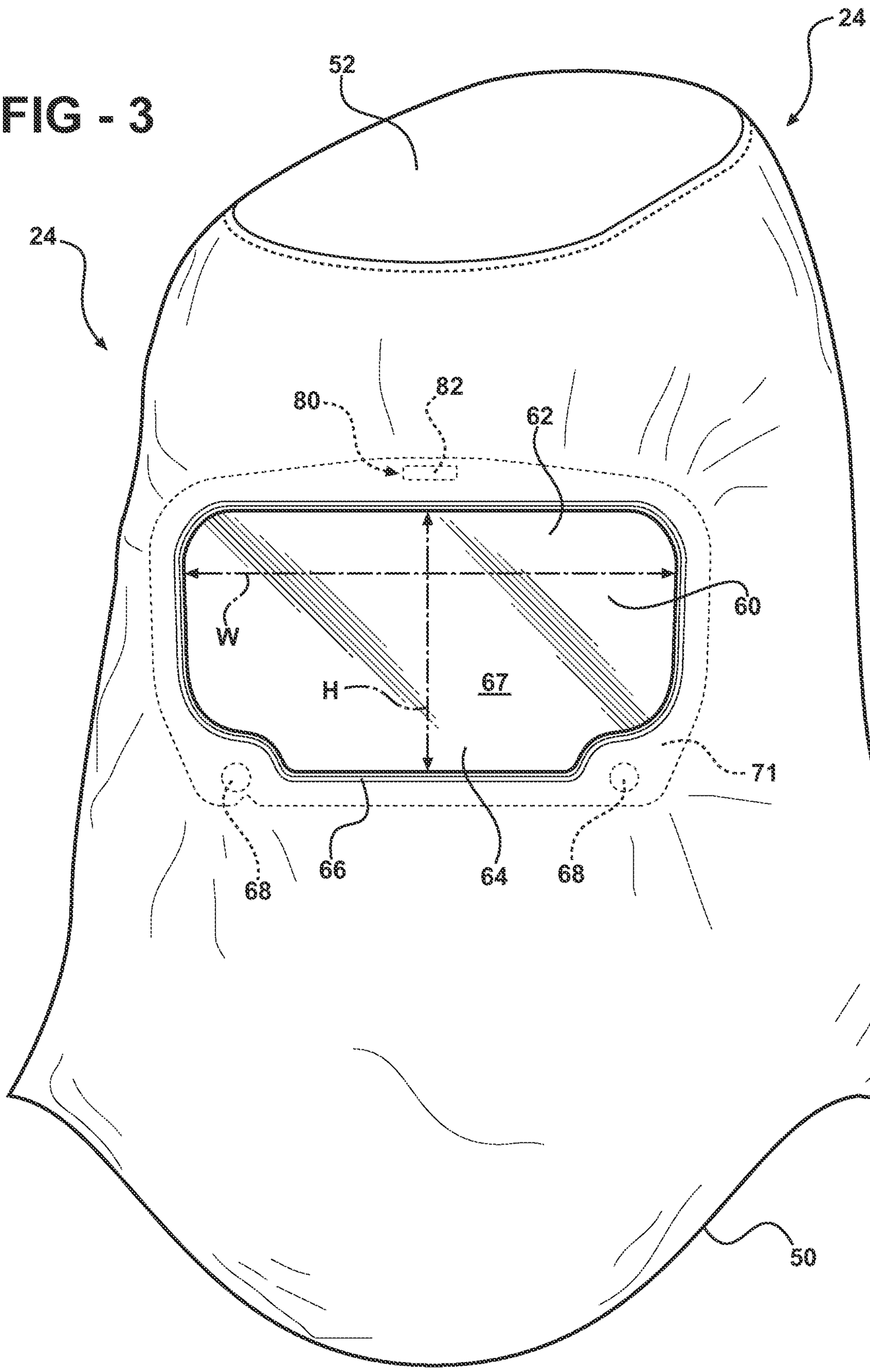


FIG - 4

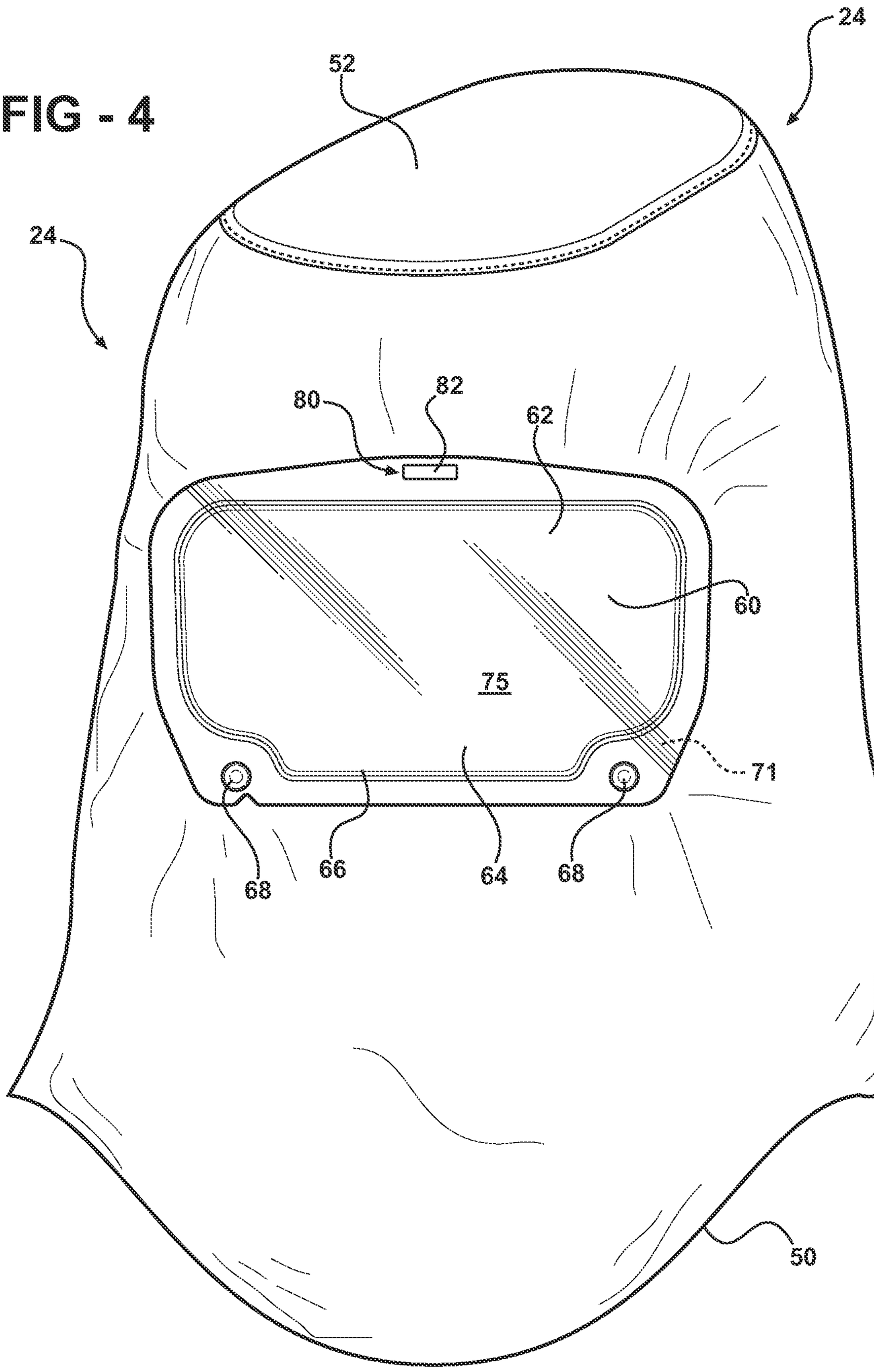


FIG - 5

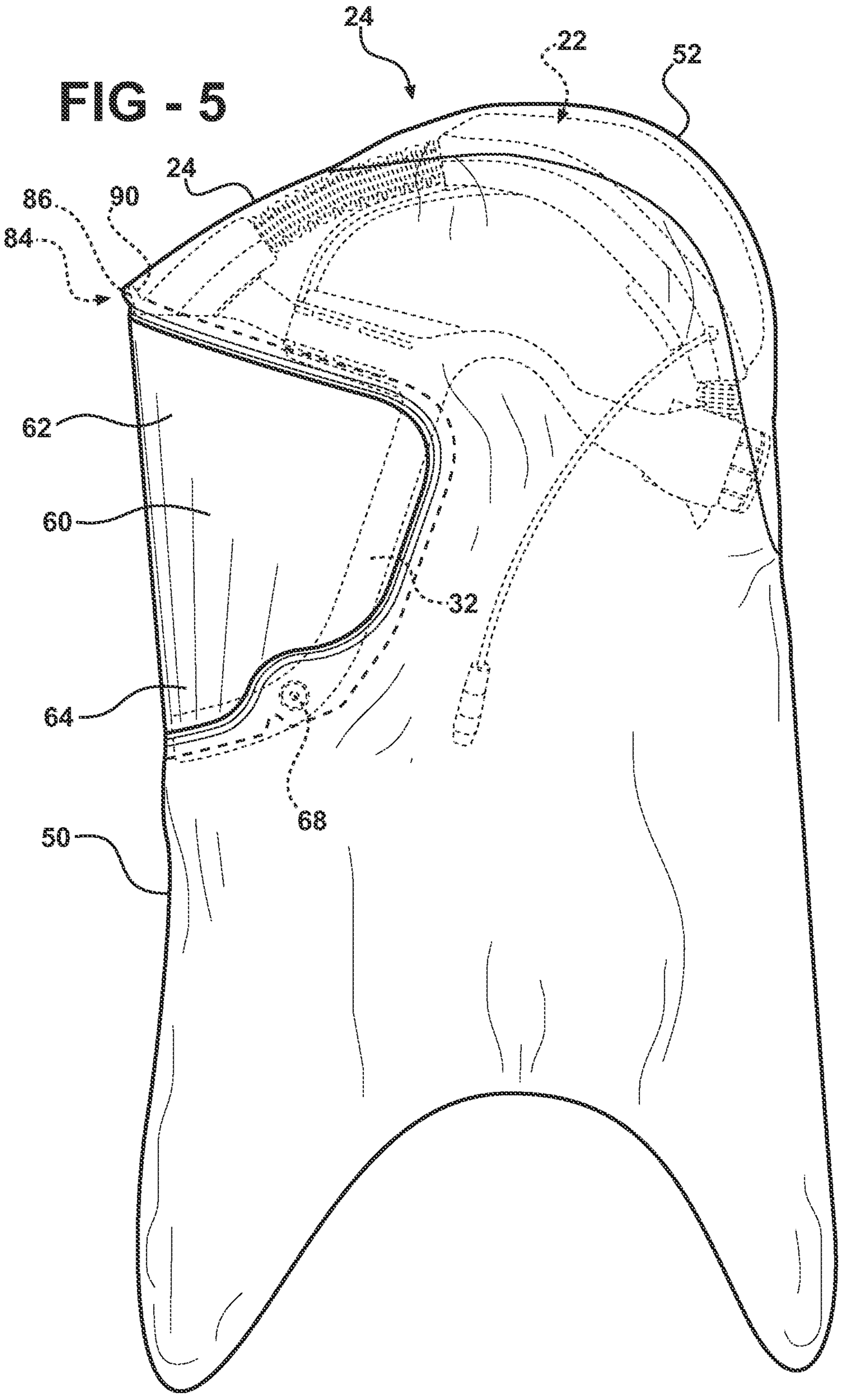
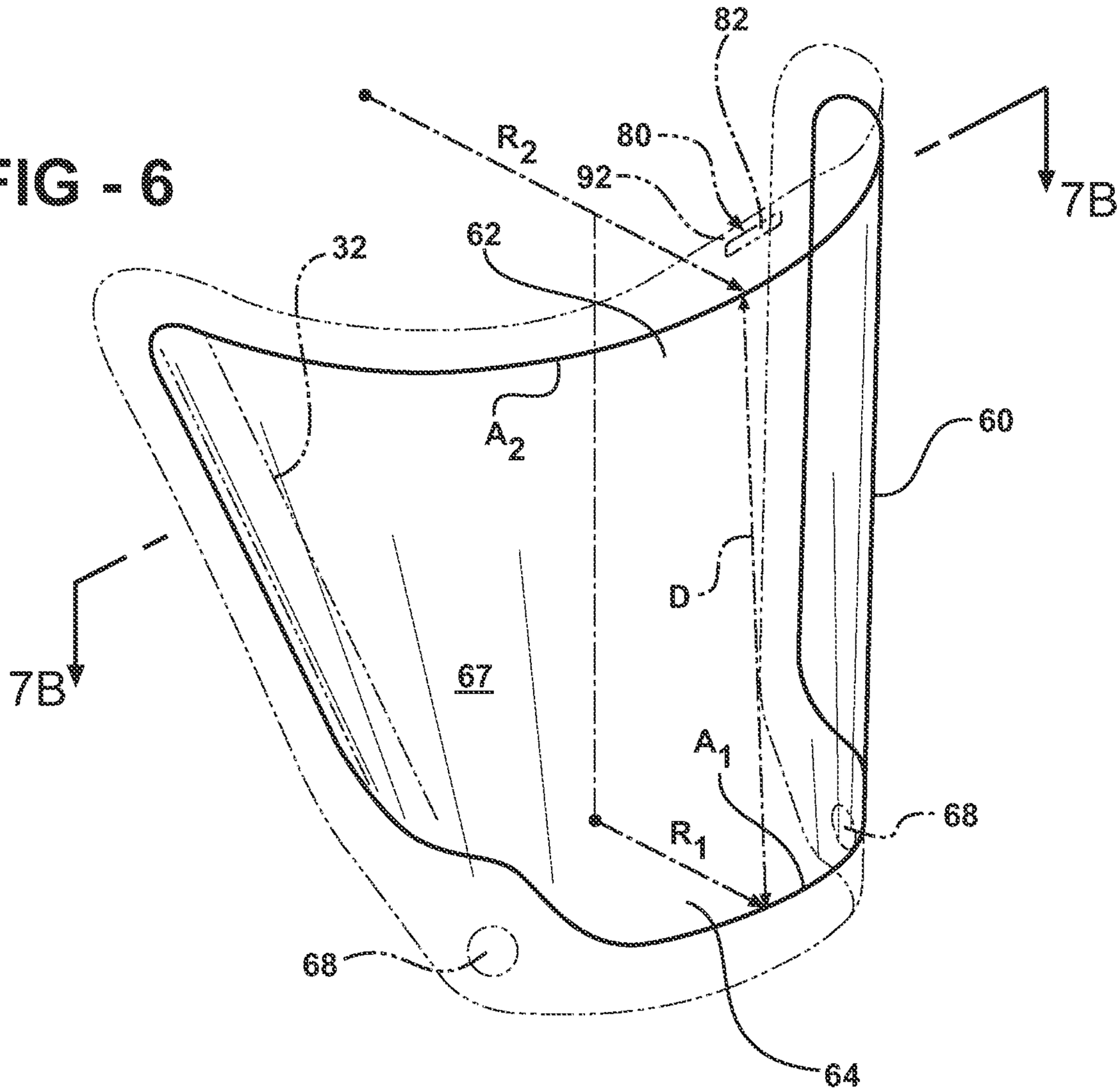


FIG - 6



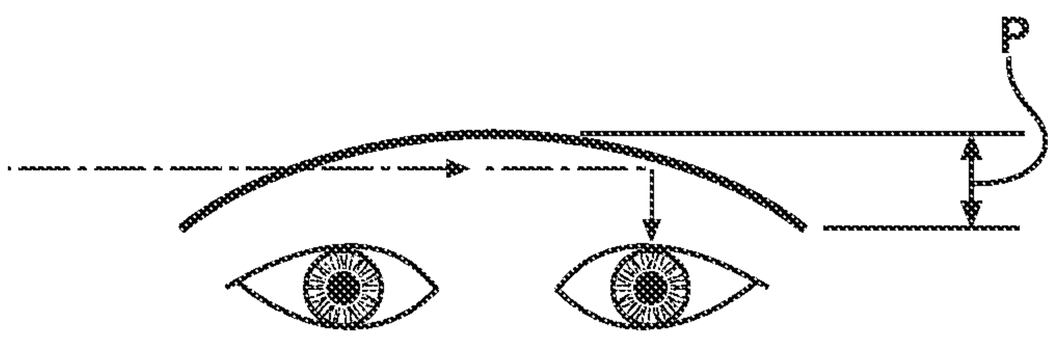


FIG - 7A
PRIOR ART

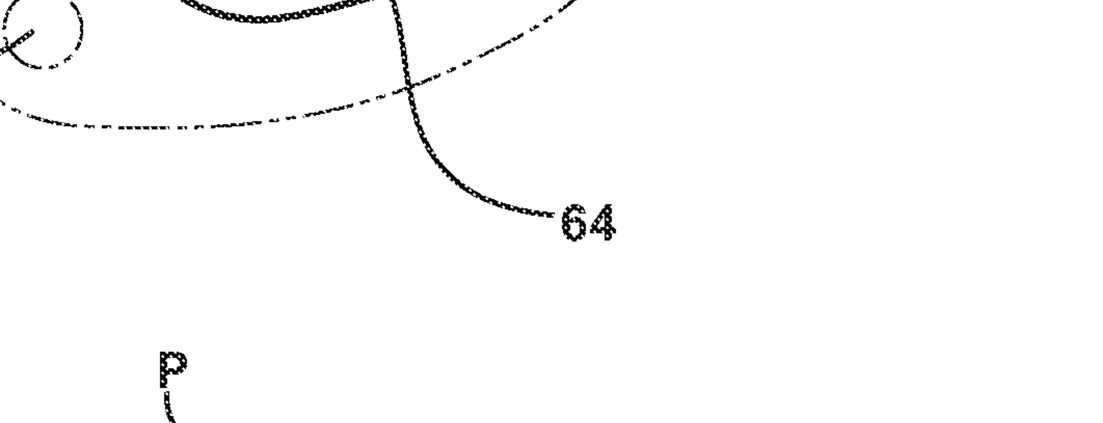


FIG - 7B

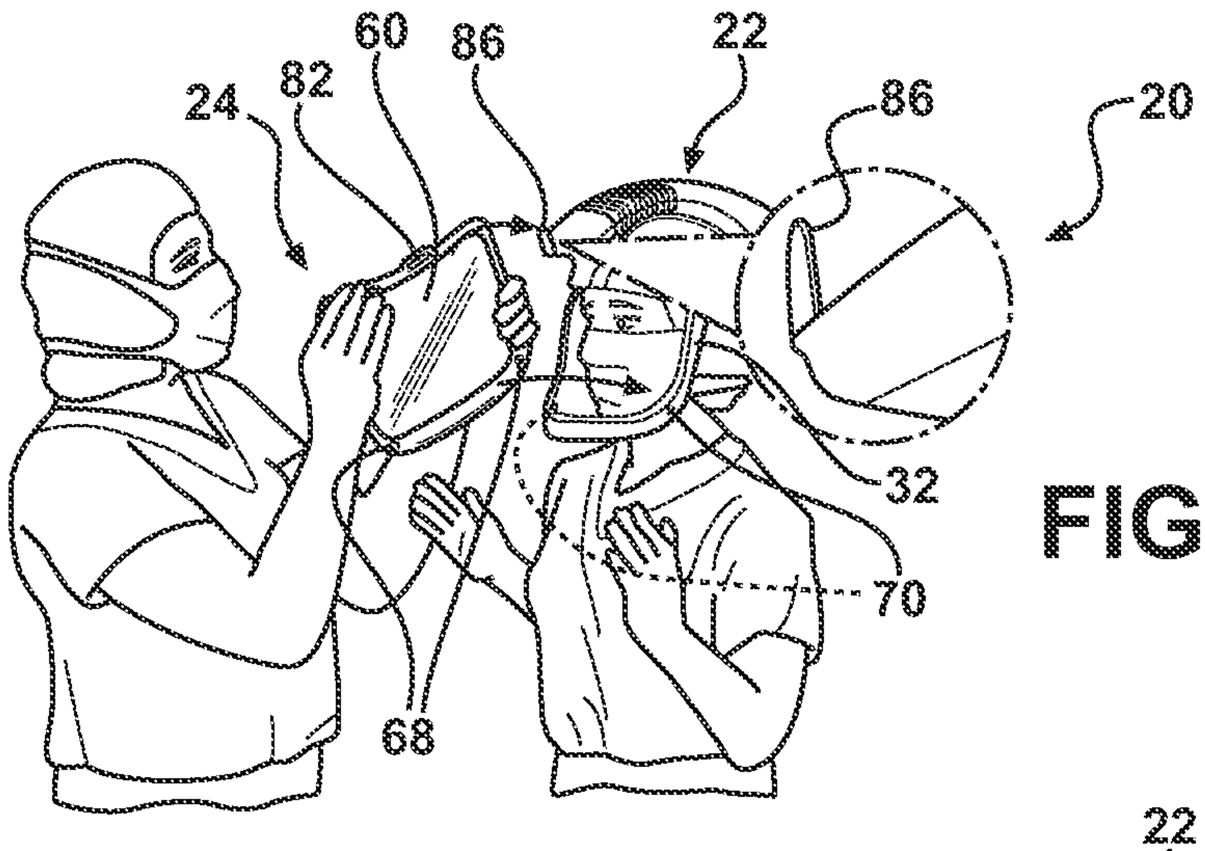


FIG - 8

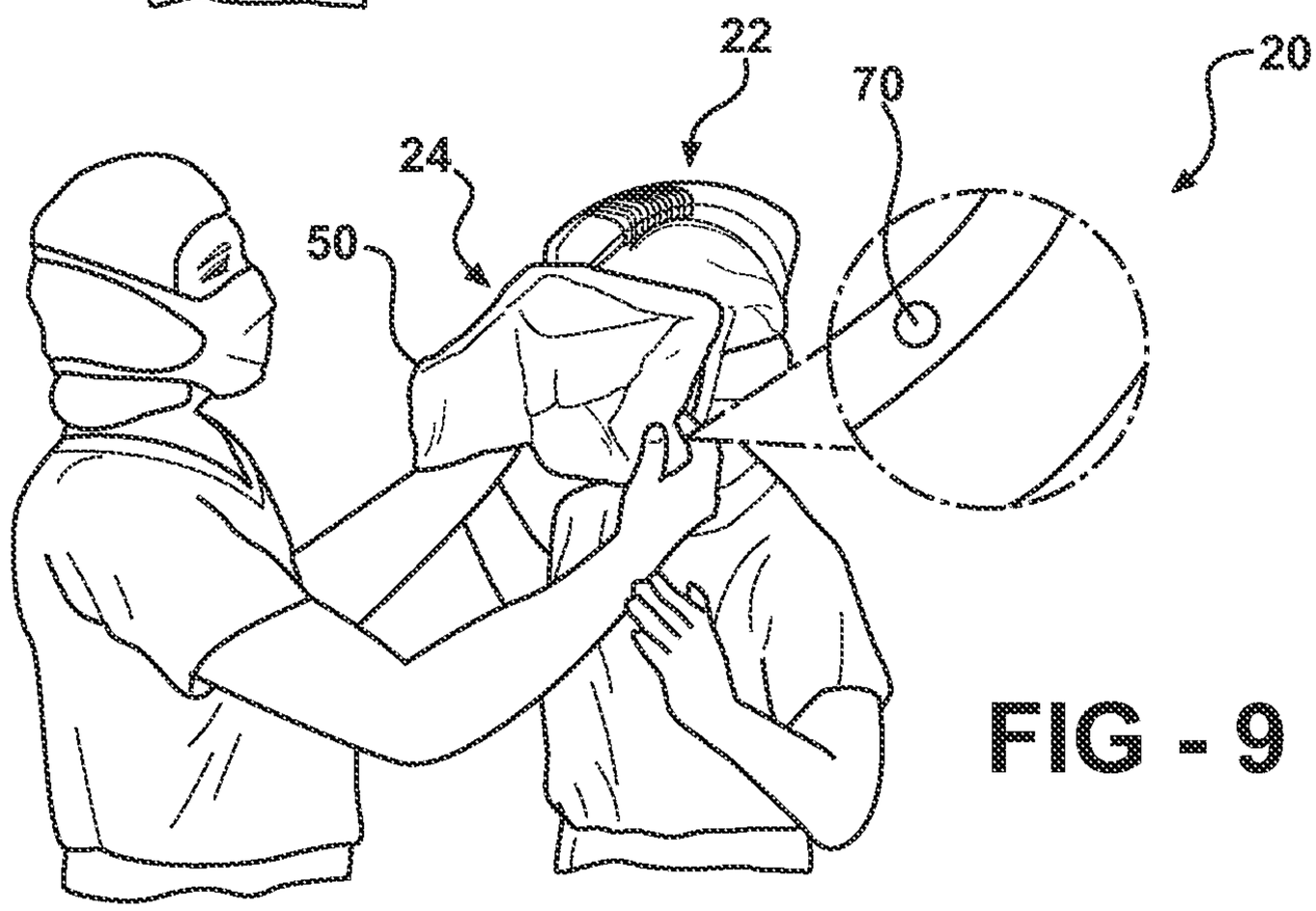


FIG - 9

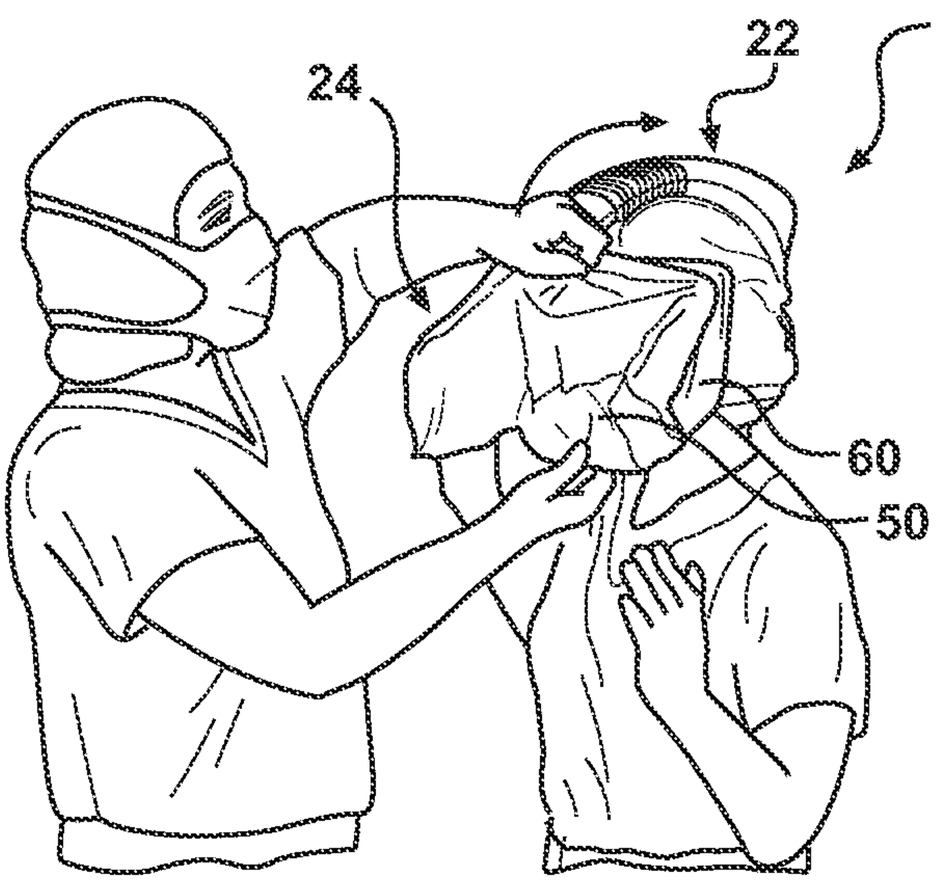


FIG - 10

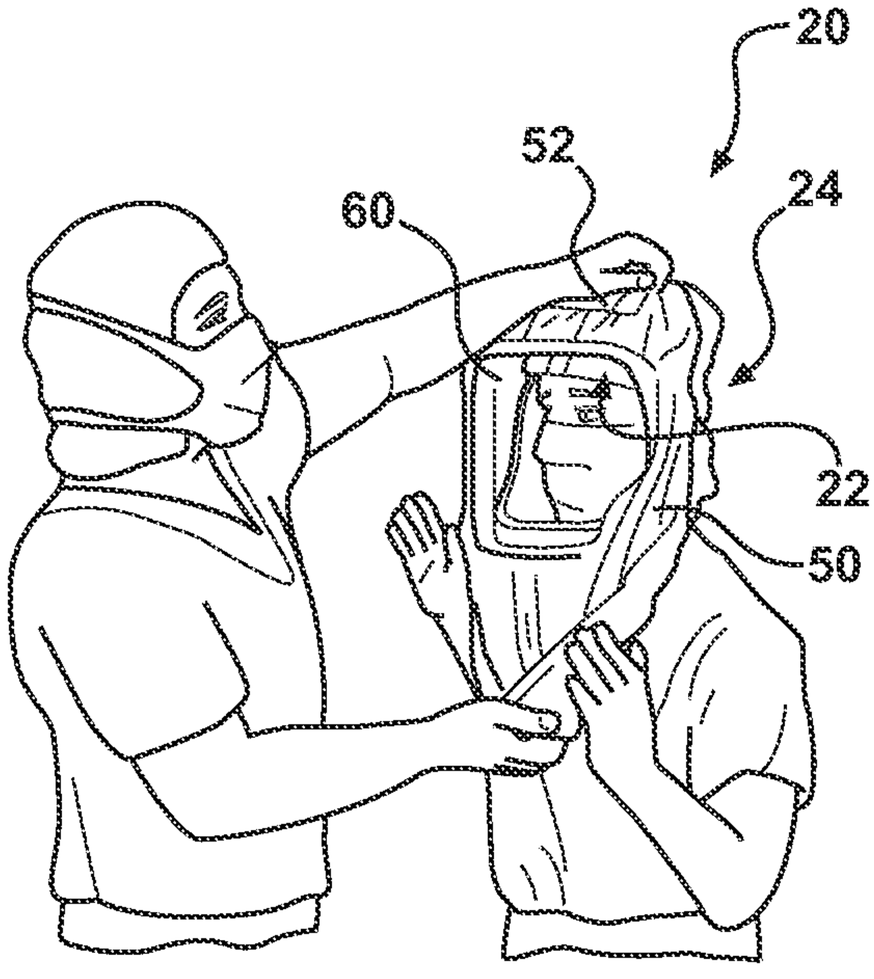


FIG - 11

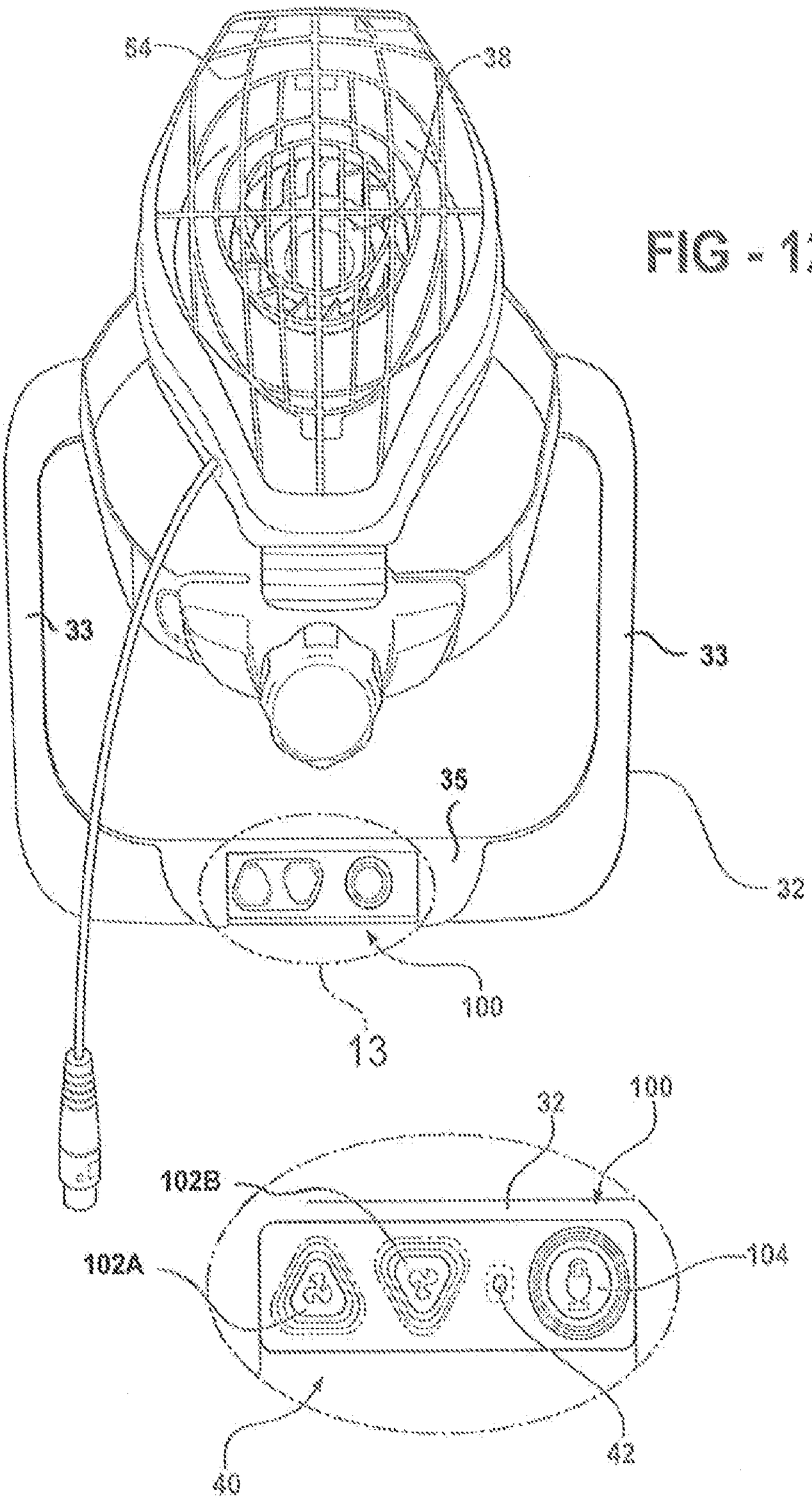


FIG - 12

FIG - 13

FIG - 5